

Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

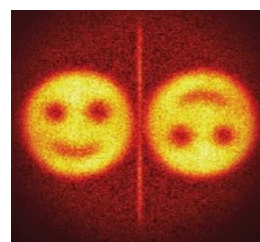
Laboratory name: Paris Institute of Nanosciences (INSP)
CNRS identification code: UMR 7588
Internship director's surname: Hugo Defienne
e-mail: hugo.defienne@insp.upmc.fr Phone number: +33652656137
Web page: www.quantumimagingparis.fr
Internship location: Sorbonne Université, campus Jussieu. 4 place Jussieu 75005 Paris
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ERC

Title: **Innovate with light: Quantum imaging, microscopy and beyond**

Topics: Experimental quantum optics, quantum imaging, microscopy, optics in complex media.

Summary: Join our team as we strive to develop tomorrow's quantum microscope! Leveraging the non-classical properties of light, such as entanglement – a topic recently honoured with the Nobel Prize in Physics in 2022, we aim to push the boundaries of classical imaging by developing innovative quantum experimental protocols. In addition, we use these tools to study and understand the mysterious properties of quantum light. **We are currently seeking a highly motivated M2 intern student to join our team with the goal of pursuing a PhD after.** A passion for physics, a problem-solving mindset, and a strong team spirit are essential attributes for the successful candidate. We have several internship projects available for prospective candidates:

- (i) Building a practical quantum phase microscope based on entangled photons (Applied optics)
- (ii) Developing a non-local imaging protocol for imaging through scattering using entanglement (Applied to Fundamental)
- (iii) Deciphering high-dimensional entanglement with cameras (Fundamental)



Quantum image from [Nat.Phys.17 \(2021\)](#)

Each project is based on ongoing experiments within the team. While a solid theoretical understanding is beneficial, the primary emphasis is on the experimental component. The specific project will be determined during interviews, considering the team's needs and the candidate's preferences. It's worth noting that the internship project's subject may or may not align with the subsequent thesis topic.

Research environment: The new student will join the Quantum Imaging Paris team. It is based in Sorbonne University, at the Paris Institute of Nanosciences (INSP), located at the center of Paris (4 place Jussieu, 75005 Paris). The team, led by Dr. Hugo Defienne, comprises 5 international PhDs and post-docs and enjoys the exceptional scientific environment of Sorbonne University with its numerous experimental and theoretical physics groups. We care for a fun, fully open and inclusive atmosphere!

Project funding: ERC Starting grant 'Structuring quantum light for microscopy' secured in 2022.

References:

- Cameron, P. et al. Quantum-assisted Adaptive Optics for Microscopy. [arXiv:2308.11472 \(2023\)](#)
- Courme, B., et al. Quantifying high-dimensional spatial entanglement with a single-photon-sensitive time-stamping camera. [Optics Letters, 48\(13\), 3439-3442 \(2023\)](#)
- Courme, B., et al. Manipulation and certification of high-dimensional entanglement through a scattering medium. [PRX Quantum, 4\(1\), 010308 \(2023\)](#)
- Defienne, H., et al. Polarization entanglement-enabled quantum holography. [Nature Physics, 17\(5\), 591-597 \(2021\)](#)

How to apply? Email to hugo.defienne@insp.upmc.fr with a CV and a short motivation email/letter.

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: NO